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Phoria measurements with alternate eye fixations in cases of anisometropia and isometropia

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Abstract

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PHORIA MEASUREMENTS WITH ALTERNATE EYE FIXATIONS IN CASES OF ANISOMETROPIA AND ISOMETROPIA

Offered in partial fulfillment
of the requirements
for the degree of
Doctor of Optometry

by
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and

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1953

A. STATEMENT:

Since it is said that the amount of accommodation being used by the individual has a definite influence on the amount of the phoria finding; and, since in the standard routines used clinically it is usually the custom to observe with one eye a target (20/20) or some print requiring an accommodative fixation, a question as to the acceptability of the phoric measurement in cases of high spherical (and cylindrical) anisometropia seems appropriate in view of the possibility of different accommodative amounts involved in a patient viewing a 20/20 target through a plus 0.50 diopter lens O.D., and a plus 4.50 diopter lens O.S.

The axiomatic procedure of the clinical routine - e.g., the substance of Von Graffe lateral phoria instructions[1] is: (1) dissociating prism before left eye and (2) measuring prism before right eye.

A rotary prism over the left eye when the displacing prism is over the right eye will give the amount of the phoria measure.[2]

Place a ten centrad prism base down before one eye - for instance, the right eye. Have the patient look at a point of light on a level with his eyes at a distance of six meters. The amount of the phoria is represented by that prism placed Base outward or Base inward before the left eye, which will bring one light directly above the other.[3]

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[1]Borish, Clinical Refraction, pgs. 232-234

[2]Maxwell, J. T., Outline of Occular Refraction, p.218

[3]Thorington, James, Refraction and How to Refract

The patient is dissociated by means of 6 diopters base up before the left eye and 15 diopters prism base in before the right eye. The patient will now have uncrossed diplopia and will see the upper target with his right eye and the lower target with his left eye. The amount of prism base-in now is reduced before the right eye until the patient reports vertical alignment of the targets.[1]

A rotary prism over the left eye when the displacing prism is over the right eye will give the amount,[2] i.e., of the phoria measure.

These instructions seem to preclude the possibility of any appreciable difference, yet it is recognized that if such a difference does exist, the fixed procedure of the prescribed phoric routine itself is responsible for obscuring information which may be of real value to the case analysis. This is apparent because it involves a habit in the phoric measurement, which measurement may or may not be sensitive to the amount of accommodation monocularly in play when testing.

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[1]Manus, Leo, Visual Analysis Handbook, pg. 44
[2]Maxwell, J. T., Outline of Occular Refraction

B. SELECTIVE FACTORS

1. Selection of an Experimental Group:

a. Having stated the problem, it was necessary to select from the clinic files of Pacific University College of Optometry a group of subjects who, during previous examination, had manifested a degree of anisometropia, in #7 of O.E.P. method of case analysis, in excess of the standard deviations for anisometropia which Dr. Carol Pratt of the faculty had, as a result of previous statistical studies, established at 0.31 diopters. Using this figure we had the basis for the selection of the experimental group, in that such a group should contain patients showing a significant amount of anisometropia in excess of the standard deviation. It was decided that only those patients showing two sigma (0.75 diopters) or more of total anisometropia would be used in the testing.

Here it is interesting to note that the major part of those cases which showed the desired degree of anisometropia were from areas which lay outside the sphere normally serviced by the clinic. This would seem then to indicate that anisometropia cases of a significant degree had not found relief for their complain as a result of previous therapy.

The Selection of Control Group:

b. The control group was governed by the same criteria as regards to the age bracket of the experimental group. Needless to say, the selection of the refractive status of the

cases used as the control group was aimed at isometropia. The spherical equivalent of those cases used did not vary more than 0.12 diopters between the right and left eye.

2. Age:

The age group was restricted; it was felt that only that group whose accommodation and convergence was well ordered would most readily demonstrate phoric responses as a result of different accommodative stimulation (i.e., anisometropia.) In keeping with this line of thought, presbyopes and children below twelve years were excluded. The average age of the experimental group (twenty subjects) was 25 years. The average age of the control group (also twenty subjects) was 26 years.

3. Acuity:

Another factor in the selection of subjects used was that 20/20 visual acuity at near was required in at least one eye. This allowed a more uniform testing group and reduced variables which are most likely present with varying acuities.

C. PROCEDURE

1. Method of Phoria Measure:

A reduced Snellen chart was used as the fixating target. This target was placed on a homogeneous white field 12 x 9½ inches. With the target set at 16", 10 prism diopters B.U. in front of the non-fixating eye, and the #7 finding in the lens bank, the phoria measurements were taken in the following manner.

The subject was asked to read the 20/20 line of the upper target and report when it was directly over the lower target. Starting with 15 prism diopters B.I., the prism was reduced till alignment was reported. Without stopping, displacement of the images was continued to approximately 6 prism diopters past alignment. Rotation of the prism was then reversed and alighment again asked of the subject. The B.I. and B.O. findings were recorded so that the mean could be computed. Base-up prism was then placed over the opposite eye and the procedure repeated.

Three phases of the phoria at 16 inches were measured; the regular 13B through the #7 lens power, then a similar phoria through the lens power of #7 -1.00 diopter and again a phoria through the #7 +1.00 diopter. These will be designated as 13B, 13B -1.00 and 13B +1.00. The phorias were measured with the right eye fixating and the left eye fixating the target. In effect, this resulted in 12 phoria measures taken with each subject.

2. Graphs and Tables:

Table #1 is a tabulation of the values obtained when taking the difference between the phoria measured with the right eye and left eye fixating. If the O.D. phoria (i.e., O.D. fixating) is greater in exophoria, it is designated as plus; if O.S. phoria is greater in exophoria than the difference is designated as a minus.

Graph #1 is a graphical representation of Table #1. Along the ordinate is plotted the frequency, while the abscissa represents the difference of the phorias when O.D. and O.S. are fixating for 13B, 13B -1, and 13B +1.

Graph #2 contains the average of the differences found when the phoria was measured through #7, #7 -1.00 and #7 +1.00 for each individual tested. The average of the differences is placed along the abscissa, the frequency along the ordinate.

Graph #3 is a presentation of all the average phoria differences between O.D. fixating and O.S. fixating, but using 1/2 diopter interval for plotting.

Graph #4 is a comparative analysis of those cases whose phoria differences exceeded one sigma and in which the following factors are considered: dominant hand, dominant eye, $\frac{\leq}{\geq}\Delta$ and the qualitative difference of the phoria.

D. DISCUSSION

1. Use of Controls:

In our use of controls, we attempted to approximate as nearly as possible the regular clinical routine so that the results obtained from the testing would be under no more artificial controls than those normally used, and the results, if significant, would be immediately applicable. Therefore, in effect, as little deviation from the regular 13B was introduced as possible; (with one exception -- i.e., the card design.)

THE CONTROLS:

a. Age
b. Degree of Aniso.
c. Acuity

) As has been previously shown (in the section dealing with the selective factors) control was exercised in these three major groupings.

d. Target - Another area of which we have previously spoken is the test card used. The target, consisting of reduced Snellen acuity letters, was printed on a 12 x 9½" card. The Standard 4½ x 5½" card of reduced Snellen acuity was not used in this testing for the reason that both clinicians and a number of their classmates , had previously noted a tendency, when disassociated, to use the vertical edge of the smaller cards for the alignment of the prism images, rather than the 20/20 line. It was felt that if the patient became aware of this gross reference structure and used it,

it could interfere with the demand we intended to place on accommodation and might materially alter the test results. The purpose of this special card then was to remove any stimulus to vision, other than the Snellen acuity letters and, therefore, maintain accommodation at as constant an acuity level as possible. It was felt that by making the peripheral field of the test card as homogeneous as possible, the only major source of reference to the patient would be the acuity letters. To avoid a view of the card clasps, another card was placed behind the experimental card, in such a manner that the card clasps adhered to the second card and were not visible. The field of vision was then homogeneous below and laterally and since the phorias were all lateral, not much weight was given to the fact that the top edge of the card remained visible.

e. Lenses and Acuity:

In those cases where bare 20/20 acuity could not be elicited through the #7 control lenses for 13B, more plus was given binocularly to allow bare 20/20 acuity. However, when testing 13B through #7 -1.00 (lens diopter) and the lenses blurred the patients, no adjustment was made in the control lenses, but the patient was told to "Try to focus the smallest letters." This was done in an effort to obtain maximal accommodation, rather than have the patient merely accept the blur, which connotes a re-

sulting relaxation of accommodation and its possible influence on the phoric measurement.

f. Illumination:

The illumination was standard for the O.E.P. routine, and constant for the three phases of the phoria measure. An average of 25 foot candles was found incident to the Snellen card.

2. Instruments Used:

One phoropter was used during the entire experiment so that differences due to mechanical factors would be as constant as possible.

3. Graphs and Tables:

In Table #1 the mean was calculated for the difference in phoria measured with right and left eye fixating through the various lens powers used. These six means varied only 0.25 prism diopters with the exception of the mean of 13B phoria taken through #7 /1.00 in the control group which varied 0.53 prism diopters. This is a good indication of the consistency that was achieved in the measuring of the phorias throughout the experiment.

Comparing the experimental and control groups in Graph #2, it is readily seen that where a significant difference in phoria measurements between O.D. and O.S. fixating was obtained, the majority were of the experimental group. The oddness of the distribution in the control group seems unexplainable. It takes on the appearance of a bimodal curve which may be due to the small number of cases represented.

Graph #3 is a composite of all the subjects tested. Since the interval of 1/4 prism diopter, which is used in the previous graph, is smaller than can be appreciated with the phoropter, an interval of 1/2 prism diopters is used. The average difference between the phoria with O.D. and O.S. fixating was plotted without regard to whether it was more exophoria or more esophoria, since the direction of change is of no importance statistically. Therefore, it is assumed that Graph #3 is one-half of a uniform distribution curve. Sigma was calculated accordingly.

Graph #4 considers only those cases which were found outside of one sigma. Of these, all were right-handed and only one was left eye dominant at near.

The three cases which showed the highest difference between phorias measured with O.S. and O.D. fixating, had a #7 of plus or minus 4.00 diopters or more in at least one eye.

Table #1

Phoria Differences Between OD & OS

Experimental Group (Anisometropic)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Mean of Phoria Differences
#13b thru #7	-1	3/4	-4	-1/8	1 1/2	1 3/4	-2 1/2	-3	1 1/2	3 1/2	-2	-3 1/4	-3 3/4	1/2	4 1/8	1/2	-1/4	-4 3/8	-1/2	2 1/2	1.73
#13b thru #7-1.000	-1 1/4	-1 1/2	-4 3/4	1	1	2 1/4	1/2	1 1/4	1 3/8	2 1/4	1 3/4	3/4	1	1 1/4	-1/2	1 1/2	1	2 3/4	-1/4	-1	1.66
#13b thru #7+1.000	-1/2	1 1/4	-3 1/2	-1 3/4	-1/2	4	0	2 3/4	-3/4	5 3/4	-2 1/2	0	-1/2	2	-3/4	2	3 1/2	1 3/4	+3/4	1 3/4	1.56
Av. of 13B diff.	-2	1/4	-4 1/2	-1/4	1/2	2 3/4	-3/4	-3/8	3/4	3 3/8	-1/2	-3/8	-1	1 1/4	-1	1 3/8	1 1/2	3/4	-1/2	1	

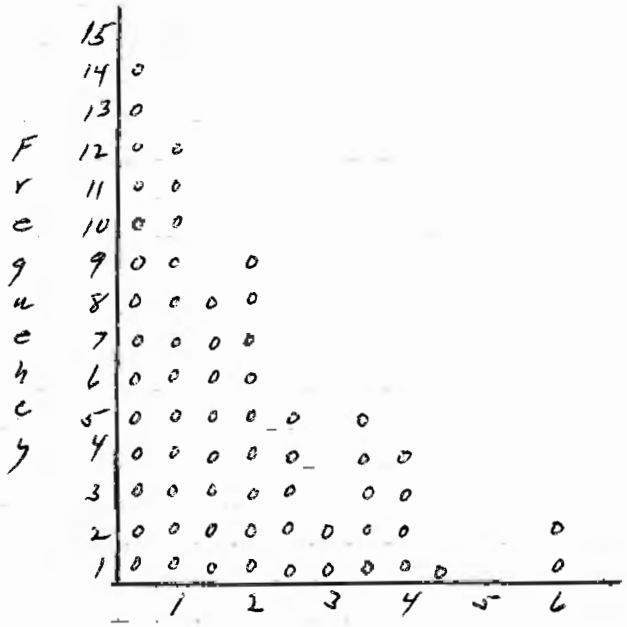
Control Group (Isometropic)

	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	
#13b thru #7	-1 1/2	-1 1/2	2 1/4	2	-4	-2 1/2	1 1/4	-3/4	1/2	4 3/4	-2 3/4	1/4	1/2	1 3/4	1 1/2	-1 1/2	3/4	-2	-3/4	1	1.66
#13b thru #7-1.000	-2 1/2	-1 1/4	2	1 1/2	1 1/2	-4 3/4	-1 1/4	-1	0	3	-1	-1	1 1/4	-1 1/2	-4 1/4	-3 3/4	-1/2	-2 3/4	1/4	-1 1/4	1.81
#13b thru #7+1.000	-2	-1	2	3/8	-2 1/4	-1/2	2 3/4	1/2	-2	1/2	1 1/4	-1/2	2	1 1/2	-1/2	2 1/4	1	-1	-1 1/4	1/4	1.28
Av. of 13B diff.	-2	-1 1/4	2	1 1/4	1 1/2	-4	1 1/4	-1/2	1/2	2 1/2	-3 1/4	-1/2	1 1/4	1/2	1/2	-1	1/2	-1 3/4	-1/2	0	

Minus = OS greater XO measure
Plus = OD greater XO measure

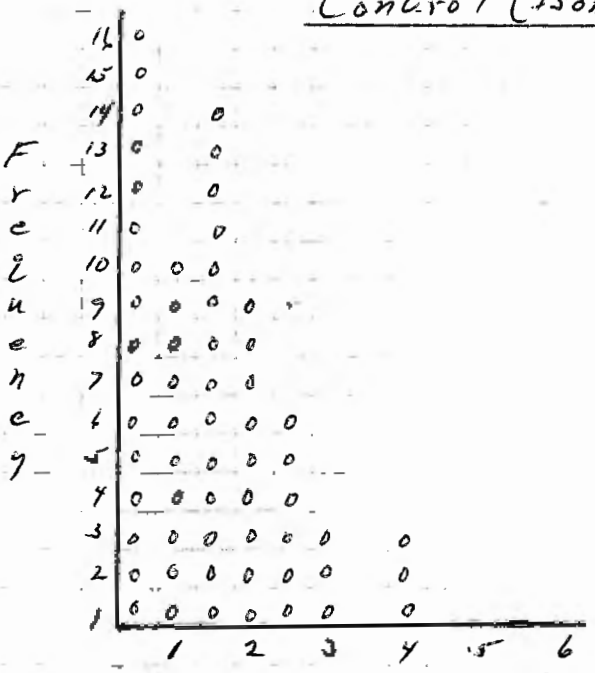
Graph #1

Experimental (Anisometropic) Group



Phoria Difference in Prism Diopters

Control (Isometropic) Group

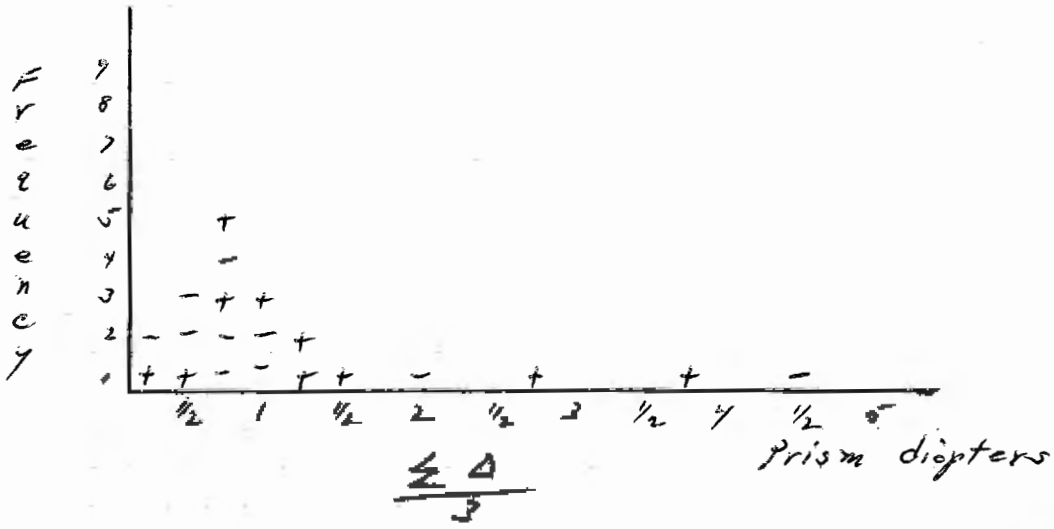


Phoria Difference in Prism Diopters

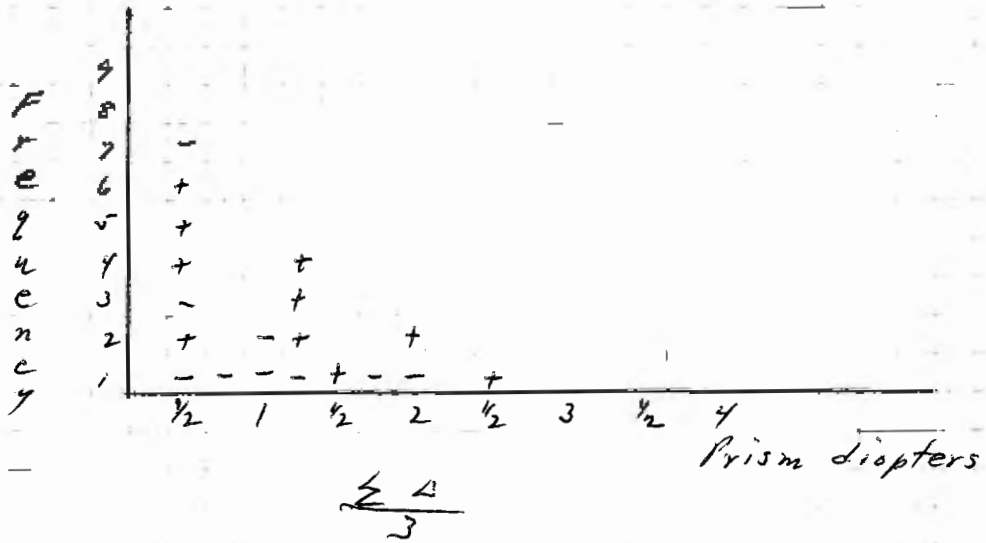
The frequency distribution of differences between OD and OS phoria measurements

Graph #2

Experimental Group (Anisometropic)



Control Group (Isometropic)



Minus = OS greater XO measure
Plus = OD greater XO measure

Calculations used in Graph #3

Frequency	Value	Deviation	(F D^2)
13	$\frac{1}{2}$	0	11
11	1	1	32
8	$1\frac{1}{2}$	2	36
4	2	3	16
1	$2\frac{1}{2}$	4	25
1	3	5	0
	$3\frac{1}{2}$	6	49
1	4	7	64
1	$4\frac{1}{2}$	8	
			233

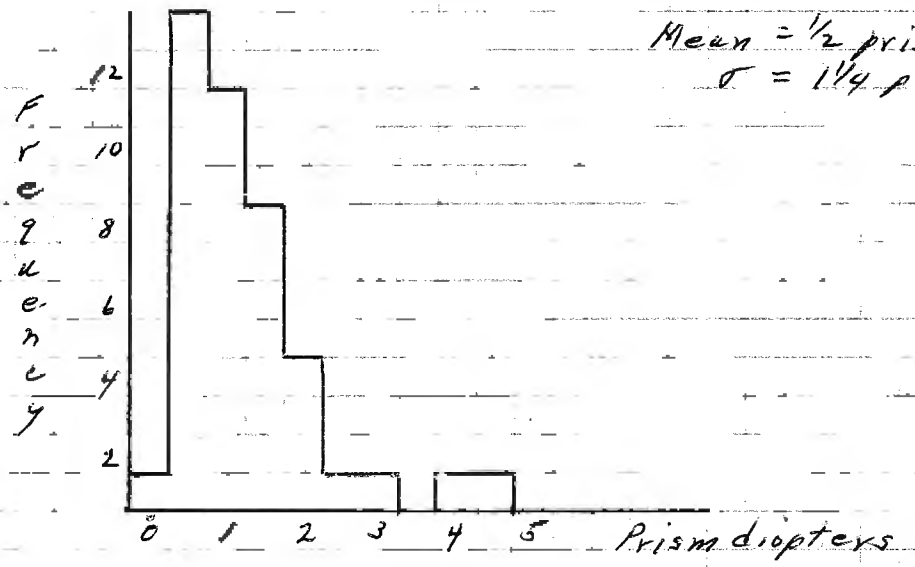
Assuming these values represent $\frac{1}{2}$ a distribution Curve:

Mean - $\simeq \frac{1}{2}$

$2 \times 233 \simeq 466$ and $\sqrt{\frac{466}{70}} = \sqrt{6.6} \simeq 2\frac{1}{2}$

$2\frac{1}{2} \times \frac{1}{2}$(actual deviation) $\simeq 1\frac{1}{4} = \sigma$

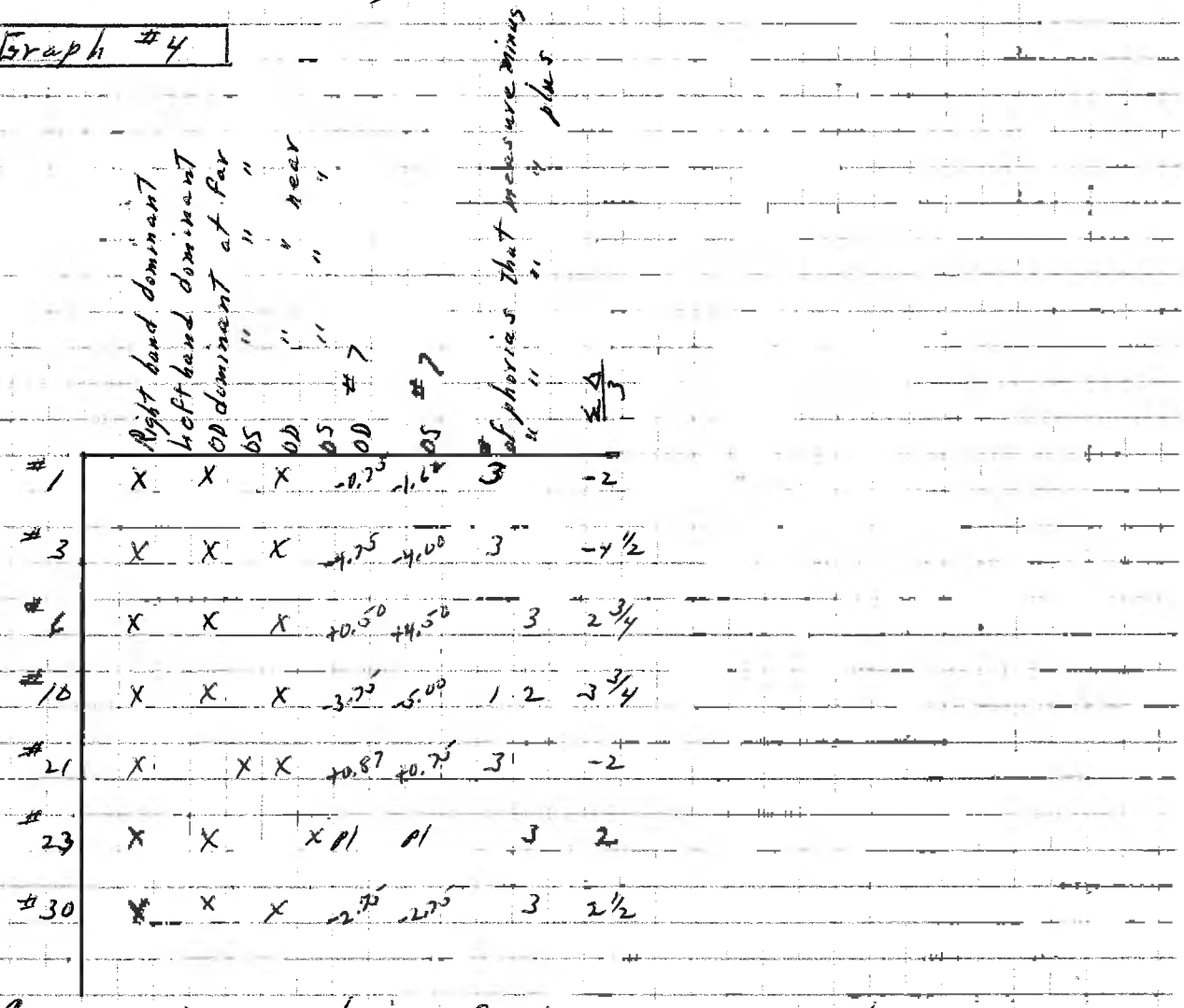
Graph #3



Mean = ½ prism diopter
σ = 1¼ prism diopter

Average phoria differences between OD and OS fixating in all cases

Graph #4



Comparative analysis of those cases whose phoria differences exceed one sigma

E. RESULTS

1. In evaluating the number of cases outside on one sigma (i.e., which demonstrated a variance between the O.D. and O.S. fixating the target in excess of 1.82 prism diopters) it was found that an almost equal number of the isometropic and anisometropic groups were present.

2. It is significant to note that only members of the anisometropic group were found beyond two sigma (i.e., demonstrated a variance between the O.D. and O.S. fixating in excess of 3.14 prism diopters.)

3. Of the group of three which fell beyond two sigma, it was further noted that in all cases the lens need of at least one eye was in excess of plus or minus four diopters and demonstrated varying degrees of anisometropia in the #7 as shown:

(1) O.D. -4.75 sphere
O.S. -4.00 sphere

(2) O.D. +0.50 sphere
O.S. +4.50 -1.75 x 72°

(3) O.D. -3.50 -0.50 x 5°
O.S. -4.75 -0.50 x 180°

4. The magnitude of difference observed in the phoria measure between O.D. and O.S. phorias was 0 to 5 3/4 prism diopters considering all cases. (I.e., the anisometropic and isometropic group.)

5. The mean of the difference between the phoria measure for O.D. and O.S. fixing was 1.65 prism diopters for the anisometropic group and 1.58 prism diopters for the isometropic group.

6. The highest differential value observed in the "bracketing technique" (i.e., a measure of the phoria for one eye by approaching from the B.I. and B.O. directions) for the anisometropic group was 5.5 prism diopters and for the isometropic group, 4.5 prism diopters.

7. As an average, it was demonstrated that the phoria measure at 16" (through #7) varied 4 prism diopters for every one lens diopter of accommodation within a range of +1.00 D. and -1.00 D. from #7. This is also in accord with the A.C.A. ratio accepted in the literature.

8. In a study of those cases lying outside of one sigma in the standard distribution curve, there was no evidence of a relationship existing between the direction of the phoria measure (i.e., esophoria or exophoria with O.D. or O.S. fixating) as it related to dominant eye or dominant hand.

F. EVALUATIONS AND CONCLUSIONS

1. While it is true that the anisometropic group did show the more marked degree of deviation, it was surprising to note that members of the isometropic group also showed significant deviation between the phorias when the O.D. and O.S. fixations were successively measured.

2. The fact that the group which fell outside of two sigma all showed a lens need of plus or minus four diopters may or may not be significant. The wide range of the degree of anisometropia found in this group does not allow us to draw any conclusion regarding the effect of the anisometropic condition.

3. Considering the degree of the variations encountered in the study regarding B.I. and B.O. phoric measurements before O.D. and O.S., the best case analysis would involve consideration of all these phoric measurements.

4. As far as can be determined statistically, there is no indication that the dominant eye of the individual will give more exophoria or less exophoria; nor does the phoria measure seem to be influenced in any statistical way by a right-hand dominance of a left-hand dominance.

5. In measurements of both the anisometropic and isometropic groups where O.D. and O.S. were successively used to fixate, a difference between the O.D. phoric measure and O.S. phoric measure up to 4 prism diopters was evident. This amount of difference could have an appreciable influence on the final lens prescribed.

SUMMARY

We observe then that the anisometropic group did show a variation in the phoria measure when the measuring prism was placed before O.D. and then O.S. Moreover, the isometropic group also demonstrated the same phenomena. From the results, therefore, it is seen that there are no grounds for ignoring the isometropic group on the assumption that an equivalent phoria will be measured both by the "bracketing technique" and by alternate fixation.

An appreciation of these phoric differences cannot help but be of value to the clinician, especially in the determination of the near nets.

It may be said then that existing phoria instructions indict themselves to an error of omission and should be broadened to emcompass a technique which requires fixation with both eyes and which "brackets" each fixing eye with a B.I. phoria measure and a B.O. phoria measure.

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